

Listing of Claims:

1. (Currently amended) A reference generator for providing a reference level, comprising:
a first nonlinear resistive element biased at a constant level to impart a first resultant level from said first resistive element;
a first mirror source in communication with the first nonlinear resistive element to receive the first resultant level and provide a first mirrored replication of said first resultant level;
a second nonlinear resistive element biased at the constant level to impart a second resultant level from said second resistive element;
a second mirror source in communication with the second nonlinear resistive element to receive the second resultant level and provide a second mirrored replication of said second resultant level; and
a reference level combining circuit connected to receive the first mirrored replication of the first resultant level from the first mirror source and the second mirrored replication of the second resultant level from the second mirror source, the reference level combining circuit creating a reference level from a combination of the first mirrored replication and the second mirrored replication ~~creates the reference level~~.
2. (Original) The reference generator of claim 1 wherein the first resistive element has a resistance different from the resistance of the second resistive element.
3. (Currently amended) The reference generator of claim 1 wherein the first and second resistive elements are multilevel magnetic tunnel junctions, each comprising multiple electrically connected magnetic tunnel junctions, wherein the magnetic orientations of the first resistive element magnetic tunnel junctions are set in a different pattern than the magnetic orientations of the second element magnetic tunnel junctions ~~set to differing parallel and anti-parallel magnetic orientations~~.
4. (Currently amended) The reference generator of claim 1 wherein the constant level is a constant ~~voltage~~ current and the first and second resultant levels and the first and second

mirrored replications are ~~currents~~ voltages.

5. (Currently amended) The reference generator of claim 1 wherein the constant level is a constant voltage and the first and second resultant levels and the first and second replications are ~~voltages~~ currents.

6. (Currently amended) The reference generator of claim [[4]] 5 wherein the reference level combining circuit comprises:

a current summing circuit to additively combine the first and second mirrored replication currents; and

a current scaling circuit to create a scaling of the combined first and second mirrored replication currents to create a reference current.

7. (Original) The reference generator of claim 6 wherein the reference level is the reference current.

8. (Original) The reference generator of claim 6 further comprising a reference resistor associated with the reference level combining circuit to receive the reference current wherein the reference level is a voltage developed across the reference resistor with said reference current flowing through the reference resistor.

9. (Currently amended) A multi level reference generator for providing a plurality of reference levels, comprising:

a plurality of resistive elements, each resistive element biased at a constant level to impart a resultant level from each resistive element;

a plurality of mirror sources, each mirror source in communication with [[the]] a corresponding one of the plurality of resistive elements such that each mirror source receives the resultant level of the corresponding resistive element and provides a mirrored replication of said resultant level; and

a plurality of reference level combining circuits, each reference level combining circuit connected to receive a first mirrored replication of one resultant level from one of the mirror source sources and a second mirrored replication of ~~[[the]]~~ another resultant level from a second one of the mirror source sources, and to combine the two received mirrored replications to create from a combination of the one mirrored replication from the one mirror source and the second mirrored replication from the second mirror source creates one of ~~[[the]]~~ a plurality of reference levels.

10. (Currently amended) The reference generator of claim 9 wherein each reference level combining circuit receives first and second mirrored replications set in a different pattern than the first and second mirrored replications of each other reference level combining circuit each resistive element has a resistance different from the resistance of each of the plurality of resistive elements.

11. (Original) The reference generator of claim 9 wherein the plurality of resistive elements are multilevel magnetic tunnel junctions set to differing parallel and anti-parallel magnetic orientations.

12. (Currently amended) The reference generator of claim 9 wherein the constant level is a constant ~~voltage~~ current and the resultant levels of the plurality of resistive elements and the mirrored replications are ~~currents~~ voltages.

13. (Currently amended) The reference generator of claim 9 wherein the constant level is a constant voltage and the resultant levels of the plurality of resistive elements and the mirrored replications are ~~voltages~~ currents.

14. (Original) The reference generator of claim 13 wherein each reference level combining circuit comprises;

a current summing circuit to additively combine the first and second mirrored replication currents; and

a current scaling circuit to create a scaling of the combined first and second mirrored replication currents to create a reference current.

15. (Currently amended) The reference generator of claim 14 wherein the plurality of reference currents created by the plurality of reference level combining circuits are the plurality of reference levels ~~the reference level is the reference current.~~

16. (Currently amended) The reference generator of claim 14 further comprising a plurality of reference resistors, each reference resistor associated with one of the plurality of reference level combining circuits to receive the reference current from the associated reference level combining circuit, wherein ~~[[the]]~~ each reference level is a voltage developed across one of the reference resistor resistors with said reference current from the associated reference level combining circuit flowing through the reference resistor.

17. (Currently amended) A method for generating multiple reference levels, comprising the steps of:

providing a plurality of resistive elements;
biasing each resistive element at a constant level to impart a resultant level from each resistive element;
replicating the resultant level from each resistive element to provide a mirrored replication of said resultant level from each resistive element; and
~~repetitively~~ combining a corresponding two of the mirrored replications ~~of the resultant levels from two resistive elements~~ to create each of the multiple reference levels.

18. (Currently amended) The method of claim 17 wherein each reference level is created from two corresponding mirrored replications set in a different pattern than the two corresponding mirrored replications of each other reference level ~~resistive element has a resistance different from the resistance of each of the plurality of resistive elements.~~

19. (Currently amended) The method of claim 17 wherein the plurality of resistive elements are multilevel magnetic tunnel junctions, each comprising multiple electrically connected magnetic tunnel junctions, set to ~~differing~~ selected parallel and anti-parallel magnetic orientations.

20. (Currently amended) The method of claim 17 wherein the constant level is a constant ~~voltage~~ current and the resultant levels of the plurality of resistive elements and the mirrored replications are ~~currents~~ voltages.

21. (Currently amended) The method of claim 17 wherein the constant level is a constant voltage and the resultant levels of the plurality of resistive elements and the mirrored replications are ~~voltages~~ currents.

22. (Currently amended) The method of claim 21 wherein ~~repetitively~~ combining a corresponding two of the mirrored replications of the resultant levels from two resistive elements comprises the steps of:

summing the corresponding two mirrored replication currents; and
creating a scaling of the summed two mirrored replication currents to create one of multiple ~~[[a]]~~ reference ~~current~~ currents.

23. (Currently amended) The method of claim 22 wherein each of the reference level levels corresponds to one of ~~[[is]]~~ the reference ~~current~~ currents.

24. (Currently amended) The method of claim 22 further comprising the steps of:
providing a plurality of reference resistors,
connecting each reference resistor to receive ~~the reference current~~ a corresponding one of the multiple reference currents ~~from each combining of two mirrored replications of the resultant levels~~, wherein each of the reference level levels is a voltage developed across a corresponding one of the reference resistor resistors with ~~[[said]]~~ the corresponding reference current flowing

through the reference resistor.

25. (Currently amended) A multilevel reference generator for providing a plurality of reference voltage levels for a sense amplifier in an array of multilevel magnetic tunneling junctions, comprising:

a plurality of multilevel magnetic tunneling junctions, each comprising multiple electrically connected magnetic tunnel junctions, each multilevel magnetic tunneling junction biased at a constant voltage level to impart a resultant current level from each multilevel magnetic tunneling junction, the multiple electrically connected magnetic tunnel junctions of ~~[[and]]~~ each multilevel magnetic tunneling junction set to ~~differing~~ a selected combination of parallel and anti-parallel magnetic orientations;

a plurality of current mirror sources, each current mirror source in communication with ~~[[the]]~~ a corresponding one of the plurality of multilevel magnetic tunneling junctions such that each current mirror source receives the resultant current level from the corresponding multilevel magnetic tunneling junction and provides a mirrored replication of ~~[[said]]~~ the received resultant current level; and

a plurality of reference current level combining circuits, each reference current level combining circuit connected to receive a corresponding first one of the mirrored current ~~replication replications of one resultant current level~~ from one of the current mirror source ~~sources~~ and a corresponding second one of the mirrored current ~~replication replications of the resultant current level~~ from a second one of the current mirror source ~~sources~~, each reference current level combining circuit creating one of a plurality of reference voltage levels using ~~[[from]]~~ a combination of the corresponding first and second ~~[[one]]~~ mirrored current ~~replication replications from the one current mirror source and the second mirrored current replication from the second current mirror source creates one of the plurality of reference voltage levels.~~

26. (Currently amended) The reference generator of claim 25 wherein each multilevel magnetic tunneling junction has a resistance different from a resistance of each of the plurality of multilevel magnetic tunneling junctions. reference level is created from two corresponding mirrored replications set in a different pattern than the two corresponding mirrored replications

of each other reference level

27. (Currently amended) The reference generator of claim 25 wherein each of the reference level combining circuit comprises:

a current summing circuit to additively combine the first and second mirrored current replications received by that reference level combining circuit; and

a current scaling circuit to create a scaling of the combined first and second mirrored current replications to create a corresponding reference current.

28. (Currently amended) The reference generator of claim 27 further comprising a plurality of reference resistors, each reference resistor [[is]] associated with one of the plurality of reference current level combining circuits to receive the corresponding reference current created by that reference level combining circuit, wherein the voltage reference level created by that reference level combining circuit is a voltage developed across the associated reference resistor.

29. (Currently amended) A multilevel magnetic random access memory comprising:

an array of multilevel magnetic tunneling junctions cells, each multilevel magnetic tunneling junction cell comprising multiple electrically connected magnetic tunnel junctions connected such that the multilevel magnetic tunneling junction cell can be programmed to represent a selected one of more than two different logical states by setting the electrically connected magnetic tunnel junctions in the cell according to a pattern of parallel and anti-parallel magnetic orientations corresponding to the selected logical state;

a sense amplifier in communication with the array of multilevel magnetic tunneling junctions to determine a data value stored within a selected cell of said array; and

a multilevel reference generator for providing a plurality of reference voltage levels for the sense amplifier, comprising:

a plurality of reference multilevel magnetic tunneling junctions, each reference multilevel magnetic tunneling junction comprising multiple electrically connected magnetic tunnel junctions set according to a selected one of the patterns of parallel and anti-parallel magnetic orientations corresponding to one of the selected logical states, each reference

multilevel magnetic tunneling junction biased at a constant voltage level to impart a resultant current level from each reference multilevel magnetic tunneling junction ~~and each multilevel magnetic tunneling junction set to differing parallel and anti-parallel magnetic orientations;~~

a plurality of current mirror sources, each current mirror source in communication with ~~[[the]]~~ a corresponding one of the plurality of reference multilevel magnetic tunneling junctions such that each current mirror source receives the resultant current level from the corresponding reference multilevel magnetic tunneling junction and provides a corresponding mirrored current replication of [[said]]] the received resultant current level; and

a plurality of reference current level combining circuits, each reference current level combining circuit connected to receive a first corresponding one of the mirrored current replication replications of one resultant current level from one of the current mirror source sources and a second corresponding one of the mirrored current replications replication of the resultant current level from a second one of the current mirror source sources, each reference current level combining circuit creating one of the plurality of reference voltage levels using ~~[[from]]~~ a combination of the corresponding first and second [[one]] mirrored current replication replications from the one current mirror source and the second mirrored current replication from the second current mirror source creates one of the plurality of reference voltage levels.

30. (Currently amended) The multilevel magnetic random access memory of claim 29 wherein, for each reference current level combining circuit, the first and second corresponding mirrored current replications replicate resultant current levels from two logically adjacent reference multilevel magnetic tunneling junctions, wherein logical adjacency is defined as two of the logical states that result in two of the resultant current levels, where no other logical state results in a resultant current level lying intermediate the two resultant current levels. multilevel magnetic tunneling junction within said array has a resistance different from a resistance of each of the plurality of multilevel magnetic tunneling junctions.

31. (Original) The multilevel magnetic random access memory of claim 29 wherein each of the reference current level combining circuit circuits comprises:

a current summing circuit to additively combine the first and second mirrored current replications received by that reference current level combining circuit; and

a current scaling circuit to create a scaling of the combined first and second mirrored current replications to create a corresponding reference current.

32. (Original) The multilevel magnetic random access memory of claim 31 wherein the multilevel reference generator further comprises a plurality of reference resistors, each reference resistor associated with one of the plurality of reference current level combining circuits to receive the corresponding reference current created by that reference level combining circuit, wherein the voltage reference level created by that reference level combining circuit is a voltage developed across the associated reference resistor with said corresponding reference current flowing through the reference resistor.